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ABSTRACT

A set of guidelines has been developed for the implementation of the audio mode in computer assisted instruction (CAI). The manual contains a collection of conventions and techniques synthesized from recent publications in areas pertinent to multi-media audiovisual presentation. These areas include audio message placement, positioning, frequency, repetition, content and length, in addition to device interplay, voice, vocabulary, tape preparation, audio script characteristics and listener instructions. Although prepared specifically for the incorporation of audio in the presentation of basic electronics subject matter by CAI, the contents of this report may be applicable to non-technical as well as other technical subject matter. A glossary and bibliography are provided. (Author/JY)

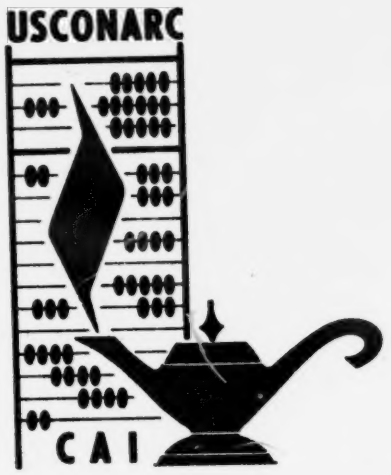
US CONTINENTAL ARMY COMMAND
COMPUTER ASSISTED INSTRUCTION PROJECT

AUDIO UTILIZATION CONVENTIONS AND TECHNIQUES FOR COMPUTER ASSISTED INSTRUCTION

ED 038027

TECHNICAL REPORT 70-1

MARCH 1970



US ARMY SIGNAL CENTER AND SCHOOL
FORT MONMOUTH, NEW JERSEY

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DEPARTMENT OF THE ARMY
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It is felt that the information contained in the reports should be made available nationally. For that reason they are forwarded for consideration for inclusion in Educational Resources Information Center journal.

Sincerely,

Harold A. Schulz

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as

HAROLD A. SCHULZ
Educational Advisor

ED038027

AUDIO UTILIZATION CONVENTIONS AND TECHNIQUES FOR COMPUTER ASSISTED INSTRUCTION

Technical Report 70-1

March 1970

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Computer Assisted Instruction Project
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FOREWORD

This report was prepared by the Federal Systems Division of the International Business Machines Corporation under Contract DAAB07-68-C-0350 in compliance with the Technical Development Plan established by the US Continental Army Command for the development of computer assisted instruction (CAI) in electronics training. It constitutes a significant contribution to this plan specifically with regard to the practices and procedures required to effectively incorporate the audio mode in CAI course materials. Much credit is due to the International Business Machines Corporation for the thoroughness with which the information for this report was researched and organized.

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ABSTRACT

This report presents a set of guidelines for the implementation of the audio mode in computer assisted instruction. It contains a collection of conventions and techniques synthesized from recent publications in areas pertinent to multi-media audio-visual presentation. These areas include audio message placement, positioning, frequency, repetition, content and length in addition to device interplay, voice, vocabulary, tape preparation, audio script characteristics and listener instructions. Although prepared specifically for the incorporation of audio in the presentation of basic electronics subject matter by computer assisted instruction, the contents of this report may be applicable to non-technical as well as other technical subject matter.

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SECTION I

INTRODUCTION

This document was prepared to provide the Computer Assisted Instruction (CAI) Project at the US Army Signal Center and School (USASCS) with guidelines required to develop the audio portion of course material presented on the IBM 1500 Instructional System. In order to facilitate and accelerate course development activity to accomplish audio implementation, discrete display techniques and rules of thumb have been delineated and synthesized from current papers, periodicals, and interviews. The two main sources for the booklet are the IBM audio preparation manuals and the USASCS CAI Project Audio Anthology. The two IBM manuals are Forms Y26-3768 and Y26-2791. The Audio Anthology is a collection of the current periodical literature and abstracts of doctoral theses written in the field of audio-visual instruction. All other individual sources considered in the creation of this book are listed in the bibliography.

Although many of the techniques suggested are general in nature and may apply to a broad spectrum of multi-media instructional requirements, the scope of this book is limited to the following considerations: (1) Can the effect of the technique have a desirable impact on the student? (2) Is the technique compatible with the USASCS CAI instructional model? (3) Can the technique be implemented within the framework of the IBM 1500 Instructional System hardware and software?

The recommended conventions for audio are considered in terms of the capabilities provided to the author of CAI course materials by the 1500 Instructional System. Variables such as message length, message positioning, and device interplay depend upon the physical characteristics of the IBM 1506 audio device and associated audio cartridge. In a similar installation using different machinery, these same decisions must be remade in terms of the new machinery. The only constraint placed on the course author by the IBM equipment is a requirement to plan audio message positioning to minimize tape search time.

In summary, the techniques and conventions presented in this document are organized by topics considered in the planning and preparation of CAI audio tapes. Each topic is divided into three discussion areas:

(1) General considerations

(2) Specific recommendations

(3) Additional suggestions and recommendations

Footnotes referring to bibliography entries are made in the text wherever a single authority can be delineated. This document has been designed for the CAI course author who is planning to use the 1506 audio device to support, reinforce, and generally enhance his development of CAI course materials with audio on the IBM 1500 Instructional System.

SECTION II

AUDIO USAGE CONVENTIONS

1. MESSAGE PLACEMENT

A. General Considerations

The instructional model developed and used by the USASCS CAI Project was designed with the hypothesis that: "Student performance increases in conceptionalizing new material when the subject matter is organized along key concept lines."[44]

By adding audio to a visual presentation capability, an additional opportunity is provided to emphasize the key points of a CAI lesson. There are three general places within the instructional model framework in which additional media might well be used to emphasize the key points in a lesson:

(1) Preconditioning Frames - All students who have failed or did not take the pre-test will be introduced to the key concepts of the lesson at these frames. High aptitude students who are aurally directed to attend to a concept at this introductory stage have a higher probability of correctly answering an associated prover frame on the first pass.[3]

(2) Remediation Frames - All remediation programmed into a lesson which contributes to the understanding of the key points whether connected to a conditioning question, a prover question, or lesson review question could be further reinforced by audio. Since most students recognize many more words in an oral context than a written one, the slower readers will probably achieve at a higher level with the additional audio referent.[21]

(3) Lesson Review Summaries - The summaries are the last places in the lesson in which the misunderstood key points of a lesson are reiterated before the student goes on to new material or proctor help.[68]

B. Recommended Message Placement Points

(1) Preconditioning Frames - To introduce and identify the key points of a lesson with emphasis.

(2) Conditioning Sequences - To provide reinforcement only where student difficulty is projected.

(3) Conditioning Question Remediation - To correctly restate a portion of a key point.

(4) Prover Question Remediation - To help correct faulty conception formation.

(5) Lesson Review Question Summary - To restate the correct concepts missed during the first pass of the lesson review.

(6) Lesson Review Correct Answer Explanation - To provide a last presentation before progression to new material or proctor help.

C. Additional Message Placement Points and Techniques

(1) Allow the student to record new words he is to learn. Aural feedback is most efficient for learning new words. Electronics formulas may be considered as words to learn.

(2) To illustrate a new concept or new information, audio reinforcement might be used in an especially difficult conditioning sequence.

(3) During a long unbroken instructional sequence, audio might be used to recapture the student's attention.

(4) Slide presentations might be more realistic and effective with sound effects as well as introductory narratives.

(5) Introductory frames for new lessons and segments might be introduced with music as well as a short narrative introduction to ease transitions between lessons and segments.

(6) Dialogues might be created for several fictitious cartoon characters presented on slides; e.g., a discussion over the pros and cons of transistors versus vacuum tubes. This effect might brighten an otherwise dull instructional sequence.

Each of the techniques in para C above may be used in para B above. The most important places for using the audio capability are those in para B which emphasize and underline the key conceptional points of each lesson.

2. MESSAGE POSITIONING

A. General Considerations

In any computer system there is an access time associated with each input/output device. Usually an attempt is made to make the most efficient use of the device in terms of its access time in relation to its other capabilities. In the 1506 random access audio device, the search speed is 19 inches per second. The 1506 is a three-track device and plays at 1-7/8 inches/second. If each message were five seconds in length, we could search through 6 messages in a second. Search time is somewhat slower in actual operation because of tape transport start/stop time. Apparent tape search time should be minimized by appropriate message positioning commands.

B. Specific Recommended Considerations Determining Message Positioning

The 1506 provides four features which allow a course author to minimize apparent access time:

(1) The audio positioning command allows the audio tape to be positioned in anticipation of a particular message playback/record request.

(2) The symbol table set feature forces two to three audio messages to begin at the same address on tape. In the case that an author requires one of several audio reinforcements ready to execute (depending on the response elicited by the student to a question frame), the author can force up to three messages to start at the same address on tape. The author controls this by using the set feature of the symbol table.

(3) The reverse packing limit determines the efficiency by which the three channels of the 1506 audio cartridge are packed with audio messages. The system reverse packing limit (RPL) is set at 120 sectors (30 seconds). This value can be overridden during assembly time by the author command: "CO." For best utilization of the 1506 packing ability, the RPL should be set at maximum (30 seconds). For minimum reverse search, the RPL should be set at the average message execution time. Except for lesson introductions, average message length will probably not exceed 10 seconds (40 sectors). In this case, it is recommended that the maximum reverse packing limit of 120 sectors.

(4) The reserve blank area option is used to reserve areas on a 1506 cartridge for future messages during assembly recovery procedures. The system is set for 120 sectors (30 seconds) to be used to define blank areas represented in the symbol table. The system value of 120 sectors can be over-ridden by the author command "CO" as in the RPL above. If the system default option were retained, each reserved area generated on tape would be 120 sectors (30 seconds), or nearly 5 feet of audio tape. Five feet of reserved tape for one message must be considered wasteful. It is recommended that the "CO" command be used to reset the blank area option before each assembly to 40 sectors (10 seconds) or to the average projected message length, whichever is longer.

C. Recommended Techniques Facilitating Message Positioning

(1) Issue a position audio tape command for the reinforcement of a question frame between the display and the response macro commands.

(2) When programming for more than three audio responses to a question frame, be sure that the first set of three audio responses will be the ones most likely picked by the student.

(3) Reset the reserve blank area option to 40 sectors prior to the audio assembly process.

(4) The shorter the average message length, the faster the 1506 will respond under a variety of search patterns.

(5) Best 1506 performance can be obtained by serial sequential access. It is recommended that when significant backward or forward searches are required, they be done with a tape positioning command while the student is occupied by a reading task.

(6) The "AUPT" macro has been inserted in the USASCS CAI Project macro system. The macro calling sequence is as follows: "CM AUPT/AANNN".

The macro is normally inserted between a visual display and a "page turner" macro. The macro will position an audio message while the student is reading the visual display, execute a "page turner" when the space bar is depressed, and immediately play the audio message positioned

previously while the visual display is till showing. The original "page turner" macro acts to enable progress to a new instructional frame. The effective coursewriter coding generated by the "AUPT" macro is as follows:

```
        BR    NEXT/S18/Ø
        AU    AANNN
        CM    PT
        AUP   AANNN
        BR    LABEL
NEXT:
```

Notice there is a branch around all of the audio oriented instruction if the particular student station does not have a 1506 audio device. (S18 = Ø).

(7) See Section III. 7. for a similar macro: "AU".

3. MESSAGE FREQUENCY

A. General Considerations

Frequency is normally given in terms of a number of events per unit time. Within CAI context, the time would be student execution time. Since there are individual differences in student response time and three paths through the instructional model, student execution time as a base for message frequency is too varied to be helpful. An audio message frequency based on the number of executed frames or number of presented slides for each of the three paths would be better.

The closest approximation of a useful message frequency lies in an analysis of those lesson frames which each student has the opportunity to execute regardless of his mainline path. Outside of the pre-test and post-test summaries, there are only three places where each of the key concepts of a lesson is directly stated: the preconditioning sequence, prover frame remediation, and lesson review question summary. In terms of the instructional model, the average audio message frequency would be at least twice per each main concept instructional sequence in the body of the lesson and twice per lesson review question.

B. Specific Recommended Audio Message Frequencies

(1) Once per each preconditioning sequence.

(2) Once per each prover frame remediation.

(3) Twice per each lesson review question.

Notice that within a particular lesson, the student is forced to listen to the key concept only once - during the preconditioning sequence.

C. Additional Considerations in Determining Message Frequency

The following additional hints may be helpful for determining the audio message frequency in instructional sequences:

(1) Messages should be planned so that every student receives audio reinforcement every two to three minutes regardless of aptitude path.

(2) Attention sets of poor readers can be restored by a small audio break or rest period.[4]

(3) Retention can be increased by reducing the number of audio messages expected at any given moment.[52]

(4) Stimulus-response learning is higher when more mediation exists between the stimulus and the response.[27]

(5) Signal detection from a posture of vigilance decreases over time.[10] In other words, vary audio reinforcement schedules for best continuous student attention. Remediation for conditioning questions is varied enough to serve this purpose for the low aptitude student.

4. MESSAGE LENGTH

A. General Considerations

Message length is not critical either from the author's or student's point of view. Length will vary according to the purpose for the message. The following list is not mutually exclusive but it suggests why different message lengths are used in a CAI environment:

(1) Tutorial exposition

(2) Substitute for reading

(3) Cueing

a. Attention getting
b. Transitions
c. Memory ticklers

(4) Conditioning

a. Reinforcing (negative and positive)
b. Extinguishing

(5) Stage setting

a. Play acting - role assumption
b. Sound effects - realism

(6) Dialogues - debating

Average messages will range from 5 to 10 seconds for most purposes. Each 1506 cartridge will play up to two hours and 40 minutes. This means 960 ten-second messages can be loaded onto a single cartridge. Cueing, conditioning, and most of stage setting can be planned to run five seconds per message. Exposition, reading substitution, and dialogues might require longer messages. In terms of purpose, audio messages can be divided into two classes:

a. Directing the student's attention to key concepts.
b. Substituting the spoken word for the written word.

The critical decision that the author should make is, "At what point do the key concept reinforcements become indistinguishable from the other audio messages?" This decision must be made for each of the three aptitude paths of the instructional model. In any instructional priority scheme, the key concepts are valued above all else.

B. Recommended Message Lengths

(1) Concept reinforcements should be no longer than ten seconds. They may average less than five seconds.

(2) Written word substitutions should be limited to specialized word lists (electronics terms) and difficult conditioning instructional sequences. This type message should be no longer than twenty seconds; average 10 seconds, and have no more than 5 in a group.

C. Additional Hints to Help Control Message Length

(1) Short skeletal word pictures are as effective as detailed word pictures in learning.[25]

(2) There is a shift from aural to visual orientation in school children. In poor readers, the shift takes place much more slowly.[39]

(3) Often, words which are not recognized visually are understood when presented aurally to poor readers.[40]

(4) Audio messages should be short, simple and direct. Inter-element pauses should be kept to a minimum.[42]

(5) Use several reinforcement schedules in audio presentations to sustain interest, attention, and performance level.[18]

5. DEVICE INTERPLAY

A. General Considerations

Regardless of instructional media used in an instructional presentation, one medium will be the author's favorite. In other words, the author will use a single medium to control his presentation and use the others for enhancement or peripheral reinforcement. In a classroom environment, the instructor cues his class, transitions from topic to topic, and generally exerts control by the sound of his voice (audio). In terms of the CAI course materials developed at USASCS, the controlling medium is the cathode ray tube (CRT) display. Paging as well as remediation are currently controlled by cues displayed on the CRT. The CRT was chosen as the controlling device for two reasons:

(1) Access time to the next frame/message was less than any other device.

(2) The CRT format was the easiest and most economical to change in terms of author time.

As the keyboard and light pen are response units, they can be considered independent competitors for station display time. It is sufficient to note that while the student station is waiting for a response, no other device can be activated. A positioning command may have been executed earlier initiating a search, but no new activity can be started until the response called for by the CRT is satisfied.

The film projector and audio device have the same priority in competing for student station time in the IBM 1500 Instructional System used at USASCS. Both units have a positioning instruction with the following characteristics:

(1) Execution of the positioning command results in an immediate search.

(2) Once a search is started, the IBM 1500 system goes on to execute the next coursewriter instruction.

(3) When the student is not wearing a headphone, the whirring sounds occurring during the search mode of the 1512 or 1506 devices may be distracting.

In addition to the capabilities of the IBM 1500 system hardware the psychological impact of device interplay on the student must be considered. The most general rule is to "Stimulate as many of the five human senses as possible".[29] Specifically, audio responses should follow the related visual presentation in time[19] and best student responses are received when there is a delay between stimulus and response.[37]

Early users of the IBM 1500 system audio device found that the effect of a sentence moving across a CRT in synchronization with an audio message was stimulating to the student. They also found that audio-visual displays would be invaluable for remediation, concept formation, and vocabulary assimilation.[65]

B. Specific Recommended Practices for Utilization of Device Interplay with the Audio Device

(1) Position the audio tape prior to related visual displays if the audio message location is more than one second away in search time.

(2) Present the audio portion of a frame after the student has had a chance to read the visual portion.

(3) The audio message should direct the student's attention to a single visual display or a portion of a single visual display.

(4) When teaching vocabulary, present the word visually, program a pause, and then present the audio message containing the word.

(5) New and difficult vocabulary words can best be presented in the desired context with a sentence. Audio should be coordinated with video as in para B(4) above.

(6) In all cases, only one visual display should be attended to during an audio message.

C. Additional Audio-Visual Effects Obtained by Utilizing Device Interplay

(1) The author may construct a sentence which moves across the CRT keeping pace with an audio message.

(2) A slide show might be given using the audio device to provide a narrative and a cue control for each subsequent slide without using the CRT at all.

(3) Introductory frames displayed on the CRT or slide projector can be highlighted by music, sound effects, or introductory narratives.

SECTION III

AUDIO SCRIPT DEVELOPMENT TECHNIQUES

1. AUDIO SCRIPT FORM UTILIZATION

A. Utilization of "Audio Script and Documentation" Form

In order to provide a complete referent necessary and sufficient to document CAI audio implementation, the "Audio Script and Documentation" form was created by the USASCS CAI Project. The vertical columns on the form were set up to link each audio script message to a symbol table entry on disk on the one hand, and a particular CAI lesson frame on disk on the other. The required narration tape, symbol table, and the placement of all individual audio instructions can be recreated from this form. Specific entries keyed to the sample of this form in Appendix A are as follows:

(1) Date:

(2) Author's Name:

(3) Course Name - Lesson: The segment name and number of the CAI course as it resides on a disk pack.

(4) Page No.: The page sequence number for a single day's script writing.

(5) Frame No.: The frame in the lesson in which the message first appears.

(6) Symbolic Label: The mutually exclusive alphanumeric symbol assigned to the message (e.g., AA1 to ZZ999.).

(7) Start Mark: The first cue mark on the narration tape before the message (e.g., BOM: beginning of message mark, or GM: group mark.)

(8) Audio Messages: Each audio message is printed or typed by the author here. Inflection, emphasis, and phrasing marks are also inserted by the author to cue trained narrators.

(9) End Mark: The terminating cue mark or cessation of a cue tone to indicate the end of a message, message segment, or group of messages.

(e.g., EOM-- end of message

EMP-- emphasis point or message "break"

GP-- group mark)

(10) Symbol Table Entry: It is recommended that the course author write every card required to recreate his entire symbol table in this column and place individual entries after the end mark for each message. This convention will simplify audio tape debugging in later steps.

B. Utilization of "Frame to Audio Label Cross Reference" Form

In order to provide a handy reference which relates a CAI course frame number to each symbolic audio message elicited by that frame, the "Frame to Audio Label Cross Reference" form was developed for course authors. This form becomes important only under the conditions that more than one audio message is used for a particular CAI frame and that an audio message primarily designed for a particular frame is used for another frame as well. Specific entries keyed to the sample of this form in Appendix A are as follows:

(1) Date:

(2) Author's Name:

(3) Course Name - Lesson: The segment name and number of the CAI course as it resides on a disk pack.

(4) Page No.: The page sequence number for a single day's work of cross referencing.

(5) Frame No.: The frame in the lesson which elicits the audio messages.

(6) Audio Label 1: The symbolic label defined in the symbol table of the first audio message elicited by this frame.

(7) Audio Label 2: The symbolic label of the second message elicited by this frame.

2. BASIC SCRIPT CHARACTERISTICS

A. General Considerations

There are certain common characteristics which exist for most scripts whether written for the screen, theater, television, or audio tape courses. Consideration should be given to these characteristics to the degree that the audio portion of a CAI course is a narrative. Individual messages will be written for special purposes which will contain only a few of these basic characteristics. In any event, it will be helpful for the author to review these characteristics when outlining a new audio lesson to help him develop an approach for his particular audio script.

B. Specific Audio Script Basic Characteristics

(1) Purpose -- Every script has a purpose or function. Define it.

(2) Setting -- Set the stage with the script. Consider the following attributes of setting.

a. Geographical location

b. Era (chronological time)

c. Immediate environment:

e.g., lab, field, classroom, etc.

d. Emotional tone or activities in process

(3) Characters -- For audio scripts, more than four characters tend to confuse. In terms of a CAI environment, a particular character development should be limited to a single conditioning chain and thus be no more than a dialogue between two characters.

(4) Timing -- The precise time action taking place is as important for an audio message in relation to a slide or CRT presentation as the instant in which the punch line of a joke is introduced in a purely narrative script.

(5) Sound Effects -- Structured sounds are most important in attention getting for the following purposes:

a. To change or create a mood.

b. To draw attention to a visual display.

c. To aid in transitioning from one theme or subject to another.

Above all, when sound effects are used, they must be realistic.

(6) Transitions -- Audio narratives, music, and sound effects can indicate divisions in CAI course material such as lessons, segments and major topics.

(7) Continuity -- A lesson must maintain a logical step by step progression. Audio can be used to tie together adjacent steps in a more logical order.

(8) Time -- Synchronizing a lesson to a classroom period is important when generating pure narratives. In generating CAI materials, other timing criteria are important. These include:

a. The number of cartridges which should be provided per week of converted classroom instruction. Early estimates based on initial lesson scripts indicate 1-1/2 to 2 audio cartridges will be used per each full week of classroom converted instruction.

b. The speed with which the fastest students execute a week of material.

(9) Action -- During a continuous audio course, changing in timing helps to imply changes in action. In CAI material, pauses would be used to emphasize or set off key points from the rest of the material.

C. Summary of Basic Characteristics of an Audio Script in Outline Format

(1) Purpose -- Define it.

(2) Setting -- Set the stage. Paint word pictures.

(3) Characters -- Keep it simple. Two is maximum for CAI.

(4) Timing -- Indicate the precise time action takes place.

(5) Sound Effects -- Be realistic. Create mood.

(6) Transition -- Indicate changes between scenes.

(7) Continuity -- Maintain a step by step progression.

(8) Total Time -- Consider the number of lessons per cartridge.

(9) Action -- Pause after key concepts.

3. LISTENER INSTRUCTIONS

A. General Considerations

In a CAI presentation, a student might experience a lull of two to five minutes between audio messages. This would be especially true of a high aptitude individual who was able to pass most pre-tests. Instructions might be given to the listener prior to beginning an audio-visual course to prepare him for an unusual presentation. The minimum instruction to the listener ought to include a request by the course author that the student set his individual volume control at the most intelligible listening level.[33]

B. Specific Recommendations for Instructions to a Listener[60]

(1) Concentrate -- The student will only get out of a course that which he puts into a course. Concentration is a self-imposed attention set.

(2) Listen for a Purpose -- Whether the course in conditionally programmed or presents a series of ideas through a single narrative, a student must understand and assimilate the main points.

(3) Listen critically -- As new information is reviewed by a student, he can understand only in terms of his previous background of knowledge.

(4) Control Prejudice -- Often, a presentation forced on a student is geared below his level of understanding or sophistication. If the student is pre-keyed to be patient, he may learn more from the presentation.

(5) Control the Room Sounds -- Even though the student may be supplied with soundproof earphones, vibrations caused by noise are distracting. "White" noise produced on a continuous basis masks random discordant sounds.

(6) Sit in a Comfortable Postion -- Students in a CAI environment may remain seated in the same carrel for prolonged periods. Legs and arms can tingle and the back muscles become tired it the student is not entirely comfortable. The usual solution to such problems is to readjust the height of the seat.

(7) Set Volume Control for the Most Intelligible Listening Level[33] -- Because of individual differences, each student will have a different threshold of aural sensitivity. Studies have shown that pre-orientation given to a student on the matter of volume control improves his subsequent performance.

4. VOCABULARY

A. General Considerations

The vocabulary level must suit the verbal ability of a typical student in the Department of Specialist Training, USASCS. With the addition of audio to CAI course material presentation, another dimension for word learning is available. It is well known there is a great discrepancy between written and spoken language. Poor readers usually have a much larger spoken vocabulary than written.[40] Listening is known to be effective in vocabulary learning[15] and may occur as efficiently for audio as for visual responses.[7] In general, audio support should be used for new vocabulary words as well as for key concepts.

B. Specific Recommendations for Vocabulary Learning

(1) Apply audio message conventions discussed in Section II of this document.

(2) Pair the display of new or difficult words with an audio message when possible.[15]

(3) For students who execute the conditioning chains, key concepts requiring new vocabulary can be taught through operant conditioning.[21]

(4) In all cases, learning word lists is best done by distributed practice.[38]

C. Specific Recommendations for Vocabulary Control

(1) Use colorful words.

(2) Use familiar words as opposed to far-fetched words.

(3) Use concrete words instead of abstract words.

(4) Use single words instead of circumlocution (beating around the bush).

(5) Use short words instead of long words.[29]

5. MESSAGE CONTENT

A. General Considerations

The best training program, of course, is the one which produces the required student behavior with the least investment of money and time. Since a training program must result in measurable dynamic behavior, the training presentation must also be dynamic and fast moving. The suggestions and rules of thumb for message content are derived from:

(1) Studies in the field of operant conditioning.[9]

(2) State of the art in audio-visual presentational psychology.[67]

(3) Military briefing rules.[13]

(4) Creative writing techniques.[13]

(5) Persuasive speaking techniques.[13]

B. Specific Recommendations Affecting Message Content

(1) Obtaining attention: The first ten seconds of a course determines the attention set of the student for the rest of the course unless the student is given powerful reasons to change.[29] Effective rules for obtaining a positive attention set include:

a. Use attention getting words in the first sentence of a presentation.[29]

b. Get the student's attention before giving the meat of a message.[58]

c. Paint word pictures to maintain interest.[58]

d. Cues, jingles, and other memory aids are excellent for maintaining attention.

e. Sound effects and music are cues for transitioning into new lessons.[58]

(2) Providing motivating responses:[29]

a. Give positive answers.

b. Be cheerful.

c. Relay answers expertly and quickly.

d. Be encouraging and complimentary.

e. Negative reinforcers work as well for learning as positive reinforcers.[8]

f. Use brief responses.

g. Present key concepts in paired audio-visual cameo formats.[67]

(3) Using figures of speech where the "flavor" of the activity is important:

a. Metaphor/Analogy: "Voltage is electrical pressure."

b. Simile: "Current in a circuit is like the speed of an auto on a turnpike."

c. Hyperbole: "An entire world of electronic troubles can be fixed by using a voltmeter."

d. Personification: "The electron is an elusive little fellow although he is easily put to work."

e. Exclamation: "Touch a charged capacitor and -- POW! -- you may get hurt."

f. Onomatopoeia: "The hissing and crackling of a high voltage wire is terrifying to behold."

(4) Maintaining simplicity of expression:[29]

a. Ideas which <u>can</u> be misunderstood, <u>will</u> be misunderstood.

b. Phrase oral questions so that there is no doubt as to what you expect.

c. Use parallel and balanced sentences

d. Use short sentences.

e. Try brevity. Be concise.

f. Use single, concrete, familiar words to express the key concepts.

6. MESSAGE REPETITION

A. General Considerations

Learning by repeating or rote is probably the oldest and most reliable teaching technique known. It is well documented that repetition of a fact decreases learning time and increases retention time. The learning curve is affected favorably for both learning and forgetting. Although the more often a thing is repeated, the more likely it is to be memorized,[3] there are several side effects to message repetition which have become known in the past ten years to affect learning adversely.

B. Specific Recommendations

(1) Distributed practice produces better learning than a series of immediate repetition.[32]

(2) More than ten uninterrupted repetitions of a reinforcer tend to extinguish the reinforcer's value.[8]

(3) Repetitions of verbal response tend to cause verbal transformations (VT)* whether or not the presentation is audio or visual.[70] (e.g., E = IR becomes I = ER).

(4) A new word, phrase, or formula should be used in several CAI lessons and in as many different contexts as appropriate.

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*See glossary: page 36

7. SPECIAL AUDIO-VISUAL PRESENTATIONS

A. General Considerations

The use of audio-visual special effects must be considered as the strategic weapons of the CAI course author. Uses of these weapons should be focused on the presentations of key lesson concepts and difficult intermediate concepts.

Although the frequency response of the 1506 audio device is limited from 100 Hertz to 7 KHz, this range is quite adequate to reproduce most familiar sounds as well as low and medium frequency music. In general, the brass section, percussion section, and stringed instruments which are plucked reproduce satisfactorily. The violin section and the higher ranges of the woodwinds do not reproduce well. Pre-recorded sound effects and narrations which are re-recorded by the narration unit and subsequently re-recorded again on to a 1506 cartridge should be tested by the course author before the final assembly is made to insure an adequate signal to noise ration on the third level tape.

The special effects capability of the 1500 system CRT is as limitless as the creative ingenuity of the CAI course author. The face of the 1510 CRT is a two dimensional matrix of 31 rows and 39 columns which each author completely controls each time he creates a frame. The course author may use the entire screen or a portion of the screen for an alphabetic letter or pictorial diagram. It has been recommended that several complete alphanumeric character sets be created and inserted on the coursewriter macro pack for the course authors to use. Letters the size of 1/3 the screen, 1/2 the screen, and total screen have been suggested. The authors need only call the specific macro and specify the CRT position of the upper left hand corner of the required letter. There are also many existent complex CRT displays which would be more valuable if available to all course authors.

The development cost of complex CRT displays can be pro-rated over a larger amount of course material if accessed by several course authors on several occasions. The sharing of displays as well as display techniques would be facilitated.

B. Specific Recommendations and Sources for Special Audio-Visual Effects

(1) Fire can be simulated by crumpling cellophane or paper while breaking small sticks.

(2) A crash can be heard when a few pie or cake tins hit the floor.

(3) Thunder is heard when a large tin plate is shaken vigorously.

(4) Surf can be made by shaking a balloon with BB's inside.

(5) An elevator sounds very much like a vacuum cleaner.

(6) Squealing brakes sound like a scraping nail across a piece of glass or metal.

(7) Escaping steam sounds like a hot soldering iron dipped in water.

(8) For a special audio-visual effect to emphasize and underline key concepts, build up large words on the CRT screen using pre-programmed macros. Then support and reinforce the bold letter with an audio message which may include background sound effects or music (e.g. "William Tell Overture" to cue the student that a key point is being displayed).

(9) An attention getting device to use during a lesson review would be a macro which elicits the following display: a numeral appears on the screen two rows high in the middle of an otherwise blank screen -- a 1/5 second pause the same numeral appears but is 16 rows tall -- a 1/5 second pause -- the same numeral appears a third time, but is 30 rows tall. Ten macros should be built, one for each number from 0 to 9. These displays would precede each summary point.

(10) Although a totally white screen might be used effectively to restore an attention set or to provide a preconditioning cue for the students, this technique requires a full video buffer for the particular student station and a correspondingly large amount of disk space in relation to an average frame.

(11) Several of the course authors in the USASCS CAI Project have recommended the use of a two row white line across the face of the CRT to be used as a fraction base line or to separate a textual question from its related remediation. A macro called "line" is suggested which the author may call and specify the starting row, column, and number of columns. When used in a fractional context, the displaying of the line can be synchronized with the audio message segment.

(12) The "AU" macro which resides on the USASCS macro system can be used for positioning, rewinding and playing audio messages.

a. Calling sequence: CM AU/P AANNN,, label.

b. Actual Coding Generated:

```
BR    Next /,S18 /,Ø
AUP   AANNN.
BR    Label.
```

Next.

C. Additional Recommendations and Sources

(1) Although there is no specific music "To Study Electronics By", there is a considerable amount of stimulating, electronically produced music available which might be used to introduce lessons. The Beatles, Jefferson Airplane, and the Bubble Gum Machine have produced albums from which satisfactory excerpts can be made.

(2) The following office:

Bill Grauer Productions, Inc.
235 W. 46th St.
New York, New York 10036

maintains an inventory including "The Sound Effects Library Series". Each album of the series is a long playing record and is available under the following titles:

a. Sounds of Auto

b. Sounds of War

c. Sounds of Aircraft

d. Sounds of Home

(3) The company listed below maintains three different volumes containing many different noises:

Audio Fidelity Records
770 11th Ave.
New York, New York 10019

SECTION IV

NARRATION TAPE PREPARATION

1. VOICE

A. General Considerations

The purpose of speech is to communicate ideas. Recent classroom case studies of individual students as well as group behavioral research studies have shown that the classroom instructor uses his voice to communicate at many more levels than indicated by any curriculum guide or lesson plan. The effective classroom instructor will develop a complex cue system through which a learning environment is maintained:

(1) For individual discipline.

(2) To maintain order in the class.

(3) To reward/reinforce student correctness.

(4) To control topical progression.

(5) To provide transition between topics.

(6) To control housekeeping tasks.

In a CAI environment, the course author must provide the same cue structure if only on an individual basis. To accomplish these tasks, the sound of the teacher's voice may be rewarding or punishing, happy or sad, authoritative or tentative, concerned or relieved, enthusiastic or bored. The emotional color transmitted by a teacher's voice is often as important as the content of the message. The natural quality of a teacher's voice determines how students will react to his teaching methods. A feminine voice has been consistently used by the telephone companies to obtain a pleasant rapport between parties on a line. Recently changed telephone numbers now have electronic audio response units attached, but the elicited voice is still distinctly feminine. Although a certain amount of decorum needs to be maintained in a military training environment, the use of a feminine voice might be useful to reinforce key points or to liven up the course during a long conditioning chain. The CAI course author should be free to try several kinds and qualities of voices in his lessons.

B. Specific Recommendations

"Voice" is a critical characteristic in persuasive speech. It is divided into four elements.[29]

(1) Volume -- Should be above the resonant level of the room.[29]

a. If sound effects are used in conjunction with a narration, they should be recorded at the same level as the voice.[11]

b. The signal to noise ratio should be at least 40dB where content is important.[22]

c. Recording level should average 100 percent modulation.

(2) Tone -- Should vary.

a. A robust voice with high sound energy is best for attention getting.[51]

b. Put a smile into your voice.[60]

c. Speak in conversational tones.[29]

(3) Rhythm -- Should vary.

a. 100 words per minute is average for audio tapes.[60]

b. Speak slowly and clearly when explaining key concepts.[60]

(4) Diction -- Must appear simple and effortless.

a. Pronunciation -- Conform to good usage.

b. Enunciation -- Must be distinct.

. . . .Unstressed vowels are more important.

. . . .Consonants must be exaggerated.[22]

Delivery is as important a characteristic as voice in persuasive speech. The key to delivery is enthusiasm. It is subdivided into three elements:

(5) Pace -- The speed of recording script material should be varied. 100 words per minute should be the average speed of the presentation.[60]

(6) Force -- Strength of the voice should vary. Key points should normally be reinforced with a strong voice.[37]

(7) Quality -- Color and enthusiasm are the most important qualities of the voice.[29]

C. Additional Recommendations

(1) In directing remediation, follow these rules of thumb:[29]

a. Give a positive answer.

b. Give a cheerful response.

c. Be encouraging and complimentary.

d. Relay your answer crisply and expertly.

(2) A variety of voices are more stimulating than a single voice:

a. Contrasting values might be examined by two characters in a dialogue.[30]

b. The audio dialogue might be used in conjunction with a slide show.

c. Audio dialogue might be created in dialect:

(e.g., Ike and Mike (Irish)
New York accent - a nagging mother)

d. More than 3 or 4 characters are hard for listener to remember.[60]

(3) The latest air traffic automatic landing systems use recorded female voices to guide pilots to safety. Pilots claim the change of pace increases alertness and decreases tension.

(4) The following narration symbols[67] are used by the Television Division, USASCS:

a. fox ↘ Deemphasize "fox".

b. fox ↗ Emphasize "fox".

c. <u>fox</u> Higher volume: level 1

d. <u>fox</u> Higher volume: level 2

e. <u>fox</u> Higher volume: level 3

f. "The red fox/jumped over/the lazy brown dog." -- The slashes indicate phrasing.

g. "The President was shot....." -- Several periods indicate a long pause in narration.

2. NARRATION TAPE PREPARATION HINTS

A. General Considerations

The following materials and personnel are needed to create a narration tape for CAI:

(1) Narration tape unit -- 2 track tape recorder with microphone.

(2) Cue tone generator.

(3) A completed audio script.

(4) Narrator.

(5) Cue tone generator operator.

The audio portion of the script will be placed on one tape track and the cue tones will be placed on the other tape track. Since the two tracks are recorded at the same time, they automatically synchronize. At least two people are needed for the recording process. The narrator is responsible for the audio track and the generator operator is responsible for the cue tone track. Both people act on the data provided by the audio script. For best results, each person should be able to perform the other's task.

When using the IBM cue tone generator, the narrator should wait before beginning a message until a beep is emitted by the generator after the beginning of message (BOM) switch is operated.

B. Specific Critical Recommendations[60]

(1) For recording purposes on both tracks, the best signal to noise ratio will be achieved when the input signal strength meters average 100 percent modulation.

(2) Rehearse the script at least once before recording.

(3) Put a smile in your voice.

(4) Hold the mike 6 to 8 inches away from your mouth.

(5) Avoid page turning, coughing, chair scraping, sneezing, etc., while recording.

(6) Use the same recording level for the subsequent dubbing of sound effects. Record the recording level on the original script each time a narration tape is created.

(7) Except where the narration tape is the final cartridge, use the inter-cue tone spaces on the narration track to indicate the symbolic label name for each message. Subsequent error correction sub-assemblies are facilitated easily with this "verbal index".

(8) The first cue tone on a narration tape ought to be preceded by an identifying narration including a "take number." This information readily identifies the position on the narration from which a final cartridge is assembled.

(9) It is suggested that group marks be placed every 50 messages or at the end of convenient lesson sub-elements. Group marks help the course author to organize his debugging effort in assembly error message recognition and symbol table/ cartridge synchronization.

3. NARRATION TAPE BYPASS TECHNIQUE

A. General Considerations

As a first cut at audio for small lessons having less than fifty audio messages, the course author may desire to create audio messages on a 1506 cartridge from any student terminal having a 1506 audio device. This process does not require the intermediate step - creation of a cued narration tape on a separate device.

The narration tape bypass technique can also be used to correct a particular garbled, or in some other way unintelligible, message on a completed tape cartridge. During the final review of a lesson, the course author can make an audio message change in a matter of seconds using this technique.

The capabilities of the 1506 which make this technique available are the absolute addressing of coursewriter audio commands coupled with the erase/record audio message command.

In both the message correction and the original script generation techniques, pretiming of each message to be inserted in the cartridge is necessary. The sweep second hand of a wristwatch is quite adequate for timing. In both cases, the associated symbol table must be updated to reflect absolute as well as symbolic synchronization with the new message. Symbol table synchronization with the audio cartridge format is critical when subsequent "AUDSUB" runs are to be made against the course segment. An updated symbol table is also useful in that subsequent message changes can be made symbolically by the author.

B. Specific Recommended Steps to Bypass Building a Narration Tape

(1) Time each message in the script in quarter seconds. Record the time beside each message.

(2) Build a symbol table using the "DA" notation. One "DA" card will be needed for each message.

a. Assign every fourth message to track Ø.

b. Start every fourth message at the next available 50th or 100th sector, whichever is closest to the end of the longest message in the previous group of three messages.

c. Be sure that the symbolic label of each "DA" card corresponds to symbolic label of each message in the script.

(3) Create an absolute "AUR" command for each audio message from an "AUDLST" run of the above symbol table.

a. Have cards punched for assembly or enter each command on line.

b. Protect this series of "AUR" commands by an absolute branch around them to a label.

c. Provide a second label prior to the first "AUR" instruction to facilitate label sequence numbering to correspond with the audio symbol sequence numbers:

(e.g., DO-1 AUR 200,0″/4Ø
DO-2 AUR 200,1″/45)

(4) Create a symbolic "AUP" command for each audio message as in item (3) above to check the playback of the message.

(5) Insert the commands created in steps (3) and (4) above into the corresponding coursewriter course segment. Execute an "AUDSUB" against the course segment to update all symbolic audio message addresses with absolute message addresses.

(6) Begin recording the audio script by executing each "AUR" command sequentially while signed on to the corresponding course segment.

a. A beep will be provided in the 1506 earphones at the beginning and ending of each recording made by the author to facilitate pacing.

b. A particular message may be re-recorded any number of times because of the erase/record mode in which the "AUR" command operates. (e.g., EX DO-1)

(7) Check each recorded message by executing through each "play command" inserted in step (4) above.

C. Specific Recommended Steps for Using the 1506 Device to Change the Contents of an Audio Message on a Completed Tape Cartridge

(1) Insert an absolute audio record command at the beginning of the corresponding course segment. The absolute address of the "AUR" command must define the limits of the current message as indicated in the corresponding symbol table.

(2) Insert an "AUP" command immediately after the "AUR" command above using the same absolute address. This command will be used to check that the re-recorded message was made satisfactorily.

(3) Record the new message through a microphone plugged into the 1506. A beep will be heard in earphones plugged into the 1506 to cue the start of the message. The "AUR" command will issue the beep when it has found the exact starting sector for the message. Another beep will indicate that the end of the message has been reached.

(4) Execute the "AUP" command to check out the message recorded above.

(5) Repeat steps (3) and (4) above as often as necessary to obtain a satisfactory recording.

(6) Delete both the "AUR" and "AUP" commands. The cartridge has been modified and is ready to be used by a student.

SECTION V

GLOSSARY

1. Attention
   -A condition of mental readiness.
   -A focusing of conciousness.
   -The act of closely observing.

2. Aural
   -Related to the human sense of hearing.
   -Implies vibrations in the range of 20 hertz to 20 kilo hertz.

3. Aural Vocabulary
   -The words which a particular human can speak and listen to with understanding.

4. Behavioral Terms
   -Overt human activity which can be observed and described by the spoken or written word. An expression from a school of educational psychology which accepts only observable organismic activity as data from which to draw conclusions.

5. CRT
   -Cathode Ray Tube: the large vacuum tube on which television pictures are seen.

6. Conditioner
   -A modifier used so that an act or response previously associated with one stimulus becomes associated with another; hence, <u>to condition</u> is to modify.

7. Cue
   -A signal which elicits a specific action, speech, or memory. The signal must mean the same thing to the giver as to the receiver to qualify.

8. Cue Tone Generator
   -A mechanical device used to synchronize a speech with some other activity.

9. Dialect
   -A manner of speaking a particular language which identified the geographical origin of the speaker.

10. Discovery Method
    -A method of teaching by which a student discerns a proper procedure from several offered alternatives.

11. Discrimination
    -The act of observing that two articles or ideas are different.

12.	**Elicit**	-To draw forth, bring out, or evoke.
13.	**Expository-Tutorial**	-An oral teaching method. A discourse delivered by the teacher from an authoritarian position.
14.	**Instructional Model**	-The current USASCS design for the flow of CAI course material by aptitude level.
15.	**Key Concepts**	-The most important statements and formulas in a body of knowledge.
16.	**Latency**	-The time interval or lull between two activities.
17.	**Mediation**	-Small conditioning steps in a learning process which lead to a larger step.
18.	**Narration Tape**	-A magnetic tape containing an audio presentation.
19.	**Noise**	-Any sound which interferes with a desired signal.
20.	**Preconditioner**	-A cue or key statement which is used to put a student in the proper condition or frame of mind in advance. Used to obtain a particular attention set at the beginning of a conditioning sequence.
21.	**Prover**	-A question which tests a student's understanding of a key point. Physically located at the end of the related conditioning chain.
22.	**Reading Vocabulary**	-The group of words a particular student recognizes and understands through usage in context.
23.	**Receptor Method**	-A teaching methodology which is directed by the teacher. Teacher controlled as opposed to learner controlled.

24. Reinforcer -A cue, stimulus, or statement which strengthens a desired concept in the mind of a student. In behavioristic terms: a cue, stimulus, or statement which adds impetus to particular student (subject) activity.

25. Remediation -Steps taken in an instructional strategy to correct faulty concept formation on a verbal level.

26. Repetition -A teaching technique used to facilitate memorization of a fact or concept. The act of repeating.

27. Response -A reaction. An activity induced by another activity. An answer a student gives when asked a question by his teacher.

28. Retention -The ability to retain. In student learning, it is the length of time required to remember or forget a fact or concept.

29. Stimulus -Something that rouses or incites to activity. In CAI terms: a question presented to a student requiring activity by the student.

30. S-R -Stimulus-Response: A stimulus conditioned to elicit the same response from a subject is called an S-R chain. When one's shoes become untied, tying activity is automatically aroused. In CAI presentations at USASCS, an "S" on the screen elicits a push on the space bar from the student; A "K" requires a keyboard entry; A "P" requires a light pen response.

31. Threshold -The limits of the ability to detect a stimulus. The measure of sensitivity to a stimulus. The limits of the awareness of a student (in non-behaviorial terms).

32.	Verbal Conditioning	-A specialized method of behavioristic instruction using only words. The words may be presented in written or aural context.
33.	Verbal Transformation	-The incorrect spelling of words caused by switching consonants or phonemes. In larger constructions, phrases and sentences might be changed in meaning by the improper placement of key words.
34.	Vigilance	-The act of attending to detect change. During the testing of a student's hearing, he would be instructed to be alert to any sound he could hear.
35.	White Noise	-A continuous repetition of a series of vibrations which tend to mask any discord or other single random vibration.
36.	WPM	-Words per minute: the notation is used in teaching typing, reading, or speaking skills.

SECTION VI

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